

# MONTHLY WEATHER REVIEW

## CONTENTS, VOLUME 98

### NUMBER 1

JANUARY 1970

On Partial Difference Equations in Mathematical Physics.....	André J. Robert, Frederick G. Shuman, and Joseph P. Gerrity, Jr.	1-6
Effects of Higher Order Advection Techniques on a Numerical Cloud Model.....	H. D. Orville and L. J. Sloan	7-13
Correction Notice.....		13
Numerical Models of a Tropical Cumulus Cloud With Bilateral and Axial Symmetry.....	F. W. Murray	14-28
Palm Sunday Tornadoes of April 11, 1965.....	Tetsuya T. Fujita, Dorothy L. Bradbury, and C. F. Van Thullenar	29-69
Power Density Spectrum of Surface Wind Speed on Palmyra Island.....	H. J. Hwang	70-74
Concentration of CO <sub>2</sub> in the Air Above a Sugar Beet Field.....	K. W. Brown and Norman J. Rosenberg	75-82
New ESSA Publication.....		82
Picture of the Month—Pacific Cyclones Viewed by ATS I.....	Frances C. Parmenter	83-84
The Weather and Circulation of October 1969—Widespread Cold With High-Latitude Blocking Over North America	L. P. Stark	85-90

### NUMBER 2

FEBRUARY 1970

A Century of Weather Science and Service.....	Robert M. White	91
Global Real-Data Forecasts With the NCAR Two-Layer General Circulation Model.....	David P. Baumhefner	92-99
On the Dynamics of Ultralong Waves in the Troposphere and Lower Stratosphere.....	G. P. Kurbatkin and N. I. Lenskinov	100-105
Experiments With a Numerical Model of Tropical Cyclone Development—Some Effects of Radial Resolution	Stanley L. Rosenthal	106-120
Selected Publications by ESSA Authors.....		121
Barotropic Stability and Tropical Disturbances.....	Frank B. Lipps	122-131
An Analytical Study of the Differential Frictional Effect on Vortex Movement.....	Gandikota V. Rao	132-135
Climatological Aspects of the Brier P-Score.....	Harry R. Glahn and Donald L. Jorgensen	136-141
An Application of Rank-Order Statistics to the Joint Spatial and Temporal Variations of Meteorological Elements	Paul R. Julian	142-153
Remarks on Thom's Estimators for the Gamma Distribution.....	L. R. Shenton and K. O. Bowman	154-160
New ESSA Publications.....		160
Picture of the Month—A WSR-57 Radar Presentation of Anomalous Propagation of Superrefraction Type	Woodrow W. Lennon and Clyde P. Thomas	161-163
Weather Note—Remarkable Point Rainfall at Greenfield, N.H., Evening of August 2, 1966	R. E. Lautzenheiser, A. E. Rothovius, and J. R. Sims	164-168
Suggestions for Authors.....		169
The Weather and Circulation of November 1969—A Circulation Reversal With Warming in the West.....	Raymond A. Green	170-174

### NUMBER 3

MARCH 1970

Simulated Climatology of a General Circulation Model With a Hydrologic Cycle: III. Effects of Increased Horizontal Computational Resolution.....	Syukuro Manabe, Joseph Smagorinsky, J. Leith Holloway, Jr., and Hugh M. Stone	175-212
Selected Publications by ESSA Authors.....		213
Correction Notice.....		213
A Note on an Improved Quasi-Lagrangian Advective Scheme for Primitive Equations.....	Mukut B. Mathur	214-219
The Dynamic Structure of Lee Wave Flow as Obtained From Balloon and Airplane Observations.....	I. Vergeiner and D. K. Lilly	220-232
A Comparison of the Wind Spectra Calculated From Data Obtained by Independent Sampling Methods	John S. Cornett and Kenneth C. Brundidge	233-237
A Generalized Probability Model for Sequences of Wet and Dry Days.....	J. R. Green	238-241
The Design and Evaluation of Hail Suppression Experiments.....	Paul T. Schickedanz and Stanley A. Changnon, Jr.	242-251
Picture of the Month—Trans-Canada Highway.....	Frances C. Parmenter	252
The Weather and Circulation of December 1969—Record December Snowfall in the Northern and Central Appalachian Mountains.....	Julian W. Posey	253-258

### NUMBER 4

APRIL 1970

The Climate of the Midnineteenth Century United States Compared to the Current Normals.....	E. W. Wahl and T. L. Lawson	259-265
The Unusual General Circulation Pattern of Early 1843.....	Hans E. Rosendal	266-270
On the Adjustment Toward Balance in Primitive Equation Weather Prediction Models.....	Hans Økland	271-279
The Eastern Pacific Hurricane Season of 1969.....	Robert A. Baum	280-292
The Atlantic Hurricane Season of 1969.....	R. H. Simpson, Arnold L. Sugg, and Staff	293-306
Atlantic Tropical Systems of 1969.....	Neil L. Frank	307-314
On the Maintenance of the Mean Monsoon Trough Over North India.....	R. N. Keshavamurty and S. T. Awade	315-320
Picture of the Month—Snowstorm in the Central Plains.....	Edward W. Ferguson	321
The Estimation of Monthly Rainfall From Satellite Data.....	Eric C. Barrett	322-327
The Weather and Circulation of January 1970—Record Cold in the Eastern Third of the Nation and Record Rainfall in the Pacific Northwest.....	A. James Wagner	328-334

## NUMBER 5

MAY 1970

Pattern Analysis of One Summer's Multilevel Maps of Montreal Rain.....	J. S. Marshall and C. D. Holtz	335-345
Characteristics of Hail-Producing Radar Echoes in Illinois.....	Neil G. Towery and Stanley A. Changnon, Jr.	346-353
Energy Conversions in a Developing Cyclone.....	Frank S. Sechrist and John A. Dutton	354-362
Vertical Motions and the Kinetic Energy Balance of a Cold Low.....	Banner I. Miller and Toby N. Carlson	362-374
On the Transient Behavior of Asai's Model of Moist Convection.....	Robert E. Schlesinger and John A. Young	375-384
Evaluation of 500-Millibar Daily and 5-Day Mean Numerical Predictions.....	James F. Andrews	385-398
Some Relationships Between 850-Millibar Lows and Heavy Snow Occurrences Over the Central and Eastern United States.....	Richard F. Browne and Russell J. Younkin	399-401
Results of a Rocket Experiment Designed to Measure Diurnal Variation of Atmospheric Ozone.....	Jagir S. Randhawa	402-405
Picture of the Month—ESSA 8 APT Shows Lee Waves Near Aleutian Islands.....	Henry W. Brandli and John A. Webb	406-407
Diurnal Variation of Wind, Pressure, and Temperature in the Troposphere and Stratosphere Over Eniwetok.....	G. C. Carlson, Jr. and S. Hastenrath	408-416
The Weather and Circulation of February 1970—Continued Mild in the West and Cold in the East.....	L. P. Stark	417-422

## NUMBER 6

JUNE 1970

On the Annual Variation of the Monthly Mean Meridional Circulation.....	Abraham H. Oort and Eugene M. Rasmusson	423-442
A Quasi-Geostrophic Model of the Winter Stratospheric Circulation.....	John H. E. Clark	443-461
"Bottom Stress Time-History" in Linearized Equations of Motion for Storm Surges.....	Chester P. Jelesnianski	462-478
Picture of the Month—A "Tehuantepecer".....	Frances C. Parmenter	479
The Weather and Circulation of March 1970—Many Wet and Cool Areas Associated With Retrogression and an Increase in Blocking.....	Raymond A. Green	480-485

## NUMBER 7

JULY 1970

Coastal Air-Circulation System: Observations and Empirical Model.....	Shih-Ang Hsu	487-509
Picture of the Month—Radar Presentation of Well-Defined Line Echoes Associated With a Cold Front.....	P. R. Gullick and C. E. Goodall	510
Selected Publications by ESSA Authors.....		511
Integration of the Primitive Barotropic Model Over a Spherical Geodesic Grid.....	David L. Williamson	512-520
Correction Notice.....		520
The Role of Large-Scale Asymmetries and Internal Mixing in Computing Meridional Circulations Associated With the Steady-State Hurricane.....	Richard A. Anthes	521-528
Some Aspects of the Radar Structure of Hurricane Beulah on September 9, 1967.....	Harry M. Hoose and José A. Colón	529-533
An Objective Analysis of Cloud Cluster Dimensions and Spacing in the Tropical North Pacific.....	C. M. Hayden	534-540
Tornadoes Associated With Hurricane Beulah on September 19-23, 1967.....	Robert Orton	541-547
Diurnal Temperature Variations: Surface to 25 Kilometers.....	J. M. Wallace and D. B. Patton	548-552
The Weather and Circulation of April 1970—Cool in the West and Warm in the East.....	Robert E. Taubensee	553-558

## NUMBER 8

AUGUST 1970

A January Simulation Experiment With the Two-Layer Version of the NCAR Global Circulation Model.....	Warren M. Washington and Akira Kasahara	559-580
Correction Notice.....		580
Selected Publications by ESSA Authors.....		581
A Regression Method for Obtaining Real-Time Temperature and Geopotential Height Profiles From Satellite Spectrometer Measurements and Its Applications to Nimbus 3 "SIRS" Observations.....	W. L. Smith, H. M. Woolf, and W. J. Jacob	582-603
The Determination of Sea-Surface Temperature From Satellite High Resolution Infrared Radiation Measurements.....	W. L. Smith, P. K. Rao, R. Koffler, and W. R. Curtis	604-611
Picture of the Month—"Rope" Cloud.....	Henry Cochran, Norman Thomas, and Frances C. Parmenter	612-613
Correspondence.....		
A Note on Forced Equatorial Waves.....	James R. Holton	614-615
A Note on Vertical Motion Analyses for the Upper Stratosphere.....	Alvin J. Miller	616-620
The Weather and Circulation of May 1970—A Generally Warm Month Associated With Small Amplitude Flow.....	Julian W. Posey	621-625

## NUMBER 9

SEPTEMBER 1970

A New Statistical Method of Estimating Surface Radiances From Corresponding Satellite Window-Channel Radiances.....	Frank L. Martin and Vincent V. Salomonson	627-634
On the Use of SIRS Data in Stratospheric Synoptic Analysis.....	Keith W. Johnson and Raymond M. McInturff	635-642
A Circularly Symmetric Primitive Equation Model of Tropical Cyclone Development Containing an Explicit Water Vapor Cycle.....	Stanley L. Rosenthal	643-663
Picture of the Month—ITOS Views.....	Matthias Eckardt and Frances C. Parmenter	664
Computational Stability and Time Truncation of Coupled Nonlinear Equations With Exact Solutions.....	F. Baer and T. J. Simons	665-679

## NUMBER 9 (Continued)

SEPTEMBER 1970

Optimum Influence Radii for Interpolation With the Method of Successive Corrections.....	J. J. Stephens and J. M. Stitt	680-687
The Effect of Initial Uncertainties on Predictions Made With Some Barotropic and Baroclinic Models.....	Madhav L. Khandekar	688-697
On the Relationship Between the Surface Stress and the Wind.....	Maurice B. Danard and Stephen Clodman	698-703
Correction Notice.....		703
High Altitude Clear Air Turbulence Probability Based on Temperature Profiles and Rawinsonde Ascensional Rates.....	David T. Prophet	704-707
Large-Scale Features of Monthly Mean Northern Hemisphere Anomaly Maps of Sea-Level Pressure.....	John E. Kutzbach	708-716
The Weather and Circulation of June 1970—A Month With Sharp Temperature Variations, Warm in the Northwest and Cool in the Southeast.....	A. James Wagner	717-722

## NUMBER 10

OCTOBER 1970

Atmospheric Gusts—A Review of the Results of Some Recent Research at the Royal Aircraft Establishment.....	J. Burnham	723-734
Diurnal Variations in Boundary Layer Winds Over the South-Central United States in Summer.....	William D. Bonner and Jan Paegle	735-744
On the Possibility of Weather Modification by Aircraft Contrails.....	Wallace B. Murcray	745-748
Correspondence		
Effect of Range on Apparent Height and Frequency of High-Altitude Radar Precipitation Echoes.....	A. J. Kantor and D. D. Grantham	748
Temperatures and Turbulence at Tropopause Levels Over Hurricane Beulah (1967).....	David E. Waco	749-755
Correction Notice.....		755
Position Determination Methods Used to Track Superpressure Balloons.....	J. E. Blamont, T. F. Heinsheimer, and J. -P. Pommereau	756-764
Monthly Charts of Surface Wind Stress Curl Over the Indian Ocean.....	Michael Hantel	765-773
Picture of the Month—Giant Icebergs in the Weddell Sea.....	Ruben Nasta and Rolando Nawratil	774-775
Incorporation of Advection of Heat by Mean Winds and by Ocean Currents in a Thermodynamic Model for Long-Range Weather Prediction.....	Julian Adem	776-786
The Annual Variation of Total Ozone in the Southern Hemisphere.....	Philip R. Sticksel	787-788
The Weather and Circulation of July 1970—Variable Weather Ending in a Period of High Air Pollution Potential in the East, Persistently Warm in the Southwest.....	Raymond A. Green	789-794

## NUMBER 11

NOVEMBER 1970

A Study of the Energetics of January 1959.....	Gaston Paulin	795-809
Numerical Experiments With a Two-Dimensional Horizontal Variable Grid.....	Richard A. Anthes	810-822
Radiation Measurements Over the Equatorial Central Pacific.....	Stephen K. Cox and Stefan L. Hastenrath	823-832
Arctic Ice and Sea Temperature Anomalies in the Northeastern North Atlantic and Their Significance for Seasonal Foreshadowing Locally and to the Eastward.....	I. I. Schell	833-850
The Unprecedented Rains in Virginia Associated With the Remnants of Hurricane Camille.....	Francis K. Schwarz	851-859
Picture of the Month—A Scalloped Squall Line.....	Frances C. Parmenter	860
Meteorological Satellite Infrared Views of Cloud Growth Associated With the Development of Secondary Cyclones.....	William E. Shenk	861-868
The Weather and Circulation of August 1970—Typical Summer Heat Associated With a Flat, Persistent Upper Level Flow.....	L. P. Stark	869-874

## NUMBER 12

DECEMBER 1970

Some Basic Formalisms in Numerical Variational Analysis.....	Yoshikazu Sasaki	875-883
Numerical Variational Analysis Formulated Under the Constraints as Determined by Longwave Equations and a Low-Pass Filter.....	Yoshikazu Sasaki	884-898
Numerical Variational Analysis With Weak Constraint and Application to Surface Analysis of Severe Storm Gust.....	Yoshikazu Sasaki	899-910
On the Meridional Distribution of Source and Sink Terms of the Kinetic Energy Balance.....	Ernest C. Kung	911-916
The Ranked Probability Score and the Probability Score: A Comparison.....	Allan H. Murphy	917-924
An Operational Technique for Relating the Movement of Existing Tropical Cyclones to Past Tracks.....	John R. Hope and Charles J. Neumann	925-933
Picture of the Month—An Atlantic Cold Front, Satellite Infrared and Visual Data Compared.....	Ralph K. Anderson	934-935
Selected Publications by ESSA Authors.....		936-937
The Weather and Circulation of September 1970—Warm in the East and Cool in the West With Heavy Precipitation in Many Central Areas.....	Robert E. Taubensee	938-943
Contents, Volume 98.....		944-946
Correction Notices.....		947
Index, Volume 98.....		947-954